

## CARTRIDGE SYSTEM FOR A PROBING HEAD FOR AN ELECTRICAL TEST PROBE

The present application is a continuation of U.S. Patent Application Serial  
5 Number 09/629,258, filed July 31, 2000. The present application is based on and  
claims priority from this application, the disclosure of which is hereby incorporated  
herein by reference.

### BACKGROUND OF INVENTION

10 The present invention relates generally to a cartridge system for a probing  
head for an electrical test probe, and specifically to a probing head cartridge system that  
includes a main probing head body and a switchable and replaceable probing tip  
cartridge.

15 An electronic test probe generally consists of a probing head, a cable, and  
a connector. The probing head may have an integral or replaceable probing tip that is  
suitable for making an electronic contact with electrical components. The probing head  
is attached to a first end of the cable and the connector is attached to the opposite end  
of the cable.

20 Electronic test probes are used to provide an electrical connection  
between electrical components and testing instruments such as oscilloscopes and other  
measuring, monitoring, diagnostic, and signal processing instruments. As the size of  
electrical components decrease, probing tips get smaller.

25 One type of probing head is a complete unit with an integral, non-  
replaceable tip. Although this type of probing head provides for an electrical connection  
with very low resistance, if the tip breaks, the entire head must be replaced. Also, an  
integral tip limits the user to a single tip unless the user replaces the entire probing  
head.

Another type of probing head includes a head assembly with a hollow socket that couples with a switchable and replaceable probing tip. One example of this type of probing head is shown in U.S. Design Patent No. 354,923 to Nightingale. One problem with this socket-type-probing head is that the tips often slide out of the socket.

5 Another problem is that the small tips are easily lost and, once lost, hard to find. Examples of other references that disclose probes with replaceable tips include U.S. Patent No. 4,552,465, U.S. Patent No. 4,849,689 to Gleason et al., Japanese Document JP11258270A, and Japanese Patent No. 10282140. In general, these replaceable probing tips are easily broken and, once broken, hard to remove and replace.

10 U.S. Patent No. 5,334,931 to Clarke et al. (the "Clarke reference") sets forth a probing head that may be readily replaced. It is designed with a cantilevered portion that is meant to reduce contact tip breakage. However, if the contact tip does break, it is easy to remove and replace. The Clark reference does not disclose a solution for modern complicated test probes that include expensive electronics and  
15 must have little or no inductance.

U.S. Patent No. 4,209,742 to Bender et al. (the "Bender reference") is directed to an electrical probe with a modular form of construction for an old technology modular probing head (signal sensing head), a cable with a plug at both ends, and an output termination. One or both plugs are suitable for connecting to the probing head.  
20 If the cable is broken, it is simply disconnected at both ends and replaced. Similarly, the probing head can be disconnected and replaced. Because the Bender reference is directed to old technology, it does not disclose a solution for modern complicated test probes that include expensive electronics and must have little or no inductance or capacitance.

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## BRIEF SUMMARY OF THE INVENTION

Unlike the prior art, the present invention provides a solution for modern complicated test probes that include expensive electronics and must have little or no inductance or capacitance.

5                   The present invention relates generally to a cartridge system for a probing head for an electrical test probe, and specifically to a probing head cartridge system that includes a main probing head body and a switchable and replaceable probing tip cartridge. The body may include a substantial portion of the electronics that make probing heads expensive. Each cartridge would include a fixed tip. However, the  
10                   cartridges could be made with different types of tips such as a pointed tip, socket tip, or grabber tip. Those embodiments in which the tips are fixed in the cartridge have significantly lower capacitance than designs in which tips are exchanged within the socket.

                  A cartridge system of the present invention includes a main probing head  
15                   body with electronics positioned therein. Further, the cartridge system includes a probing tip cartridge having a probing tip. An electrical contact mechanism electrically couples the electronics to the probing tip when the probing tip cartridge is in mating relationship with the main probing head body. The types may be, for example, a pointed tip, a socket tip, or a grabber tip.

20                   The foregoing and other objectives, features, and advantages of the invention will be more readily understood upon consideration of the following detailed description of the invention, taken in conjunction with the accompanying drawings.

## BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

FIG. 1 is an exploded perspective view of one preferred embodiment of a probing head cartridge system of the present invention including a main probing head body and a probing tip cartridge.

5                   FIG. 2 is a cross-sectional side view of the probing head cartridge system showing the internal electronics and the electrical contact mechanism contacting a conductive surface when the probing tip cartridge is in mating relationship with the main probing head body.

FIG. 3 is a cross-sectional bottom view of the probing tip cartridge.

10                  FIG. 4 is an exploded perspective view of an alternate preferred embodiment of a probing head of the present invention.

FIG. 5 is an exploded perspective view of one preferred embodiment of an electrical test probe with an integrated grabber cartridge of the present invention including a main probing head body and a probing tip grabber cartridge.

15                  FIG. 6 is an exploded cross-sectional side view of the electrical test probe with an integrated grabber cartridge.

FIG. 7 is a bottom view of the integrated grabber cartridge.

FIG. 8 is an exploded perspective view of an alternate preferred embodiment of a probing head with an integrated grabber of the present invention.

20                  FIG. 9 is a perspective view of an integrated grabber coupling with a circuit board device.

## DETAILED DESCRIPTION OF THE INVENTION

As shown in FIGS. 1-3, the present invention is directed to a cartridge system 20 for a probing head 22 for an electrical test probe that includes a main probing head body 24 and a switchable and replaceable probing tip cartridge 26. The main probing head body 24 may include a substantial portion of the electronics 28 that make probing heads expensive. And the probing tip cartridge 26 would include a probing tip 30 such as a pointed tip (FIG. 4), socket tip (FIGS. 1 and 2), grabber tip (not shown), or any other type of probing tip.

As shown in FIGS. 1 and 2, the main probing head body 24 has an interior compartment in which the electronics 28 are positioned. The main probing head body 24 also has an external peripheral surface 25. Having electronics in the main probing head body 24 is important because it can be used to amplify a portion of the signal for transmission back to the testing instrument without altering the signal. It should be noted that both active and passive electronics are contemplated as "electronics" herein. Older technology did not need electronics in the probing head 22.

An electrical contact mechanism 32 is electrically coupled to the electronics 28. The electrical contact mechanism 32 may be, for example, a signal spring contact, a leaf spring, a pogo pin, or a coil spring. These exemplary electrical contact mechanisms 32 are not meant to limit the scope of the invention. In the preferred embodiment, the electrical contact mechanism 32 protrudes from the main probing head body 24. This is shown in FIGS. 1 and 2. Further, as shown in FIGS. 1 and 2, the electrical contact mechanism 32 may protrude from the external peripheral surface 25.

A probing tip cartridge 26 of the present invention includes a probing tip 30 with a conductive exterior surface such that at least part of the conductive surface is exposed to form an exposed conductive surface 34. FIG. 4 shows an integral probing tip. FIGS. 1-2, however, show a socket probing tip 30 for coupling with a secondary probing tip 36. If a secondary probing tip 36 is used, it is in electrical connectivity with the exposed conductive surface 34. The electrical contact mechanism 32 contacts the

conductive surface 34 when the probing tip cartridge 26 is in mating relationship with the main probing head body 24.

In an alternate embodiment (not shown) an electrical contact mechanism could be integrated into the probing tip cartridge 26 so that it protrudes therefrom. In this alternate embodiment (not shown), the electrical contact mechanism would contact a conductive surface on the electronics 28 when the probing tip cartridge 26 was in mating relationship with the main probing head body 24.

If the probing head 22 shown in FIG. 2 were used to probe a component on a circuit board, the signal would follow the following exemplary path. First, as the secondary probing tip 36 touched the circuit board component, the signal would enter the secondary probing tip 36. The signal would then travel from the secondary probing tip 36 to the primary probing tip 30. As the primary tip 30 has an exposed conductive surface 34 the signal would travel from the exposed conductive surface 34 to the electrical contact mechanism 32. The electrical contact mechanism 32 would then allow the signal to flow to the electronics 28. Finally the signal would go through the cable 38 to the testing instrument 40.

The cartridge system as shown preferably has a main probing head body 24 with a set of gripping jaws 41a and a probing tip cartridge 26 with a set of gripping surfaces or rails 41b. The gripping jaws 41a grip the gripping surfaces 41b to hold the probing tip cartridge 26 in place. The probing tip cartridge 26 may be further secured by a foot 42 extending into the main probing head body 24 through an opening 44 defined therein. Alternatively, as shown in FIG. 4, the probing tip cartridge 26 may be held in place by a rear boot 46 gripping both the probing tip cartridge 26 and the main probing head body 24.

FIGS. 5-9 show various embodiments of an integrated grabber 100. FIGS. 5-7 show an integrated grabber cartridge system in which the main probing head body 24 is substantially similar to that shown in FIGS. 1-4. The cartridge, however, is an integrated grabber cartridge 120. The actuator 126 and grabber tip 128 are exposed from the integrated grabber cartridge 120 at opposite ends so that by pushing and

pulling the actuator 126 the grabber tip 128 opens and closes. It should be noted that alternate actuating means are possible (for example, a side actuator). FIG. 8 and 9 shows an alternate embodiment of the integrated grabber in which the grabber is integrated into a cartridge that can be attached to a probing head body.

5                   A method for using a cartridge system 20 of the present invention includes the step of protruding the electrical contact mechanism 32 from the main probing head body 24. Then the probing tip cartridge 26 is brought into mating relationship with the main probing head body 24. This causes the electrical contact mechanism 32 to be coupled electronically with the conductive surface 34. Finally, the probing tip cartridge  
10   26 is secured in mating relationship with the main probing head body 24.

                  It should be noted that the step of bringing the probing tip cartridge 26 is brought into mating relationship with the main probing head body 24 may be done in many ways. For example, as shown in FIGS. 1 and 2 the probing tip cartridge 26 may be slid forward so that the gripping surfaces 41b forward into the gripping jaws 41a. In  
15   FIG. 4, on the other hand, the probing tip cartridge 26 slides backward into mating relationship with the main probing head body 24. Other types of connections could be used, for example, the probing tip cartridge 26 could be snap fit into mating relationship with the main probing head body 24. Other examples include adhesive, mechanical connectors, friction fits, or trapped in a living hinge.

20                   It should be noted that the step of securing the probing tip cartridge 26 and the main probing head body 24 in mating relationship might be done in many different ways. For example, FIGS. 1-3 show an embodiment in which the step of securing further includes the step of extending a foot 42 of the probing tip cartridge 26 into the main probing head body 24 through an opening 44. Alternatively, FIG. 4 shows  
25   an embodiment in which the step of securing further includes the step of gripping both the probing tip cartridge 26 and the main probing head body 24 with a rear boot 46.

                  The method of the present invention also contemplates switching or replacing the probing tip cartridge 26 as needed by the user. To switch the probing tip cartridge 26 the user first releases the probing tip cartridge 26 from its mating

relationship with the main probing head body 24. Then the user removes the probing tip cartridge 26. Next, the user provides a replacement probing tip cartridge 26 having a probing tip 30 with a conductive surface 34 defined therein, at least part of the conductive surface 24 being exposed. The user then brings the replacement probing tip cartridge 26 into mating relationship with the main probing head body 24. In doing this step the electrical contact mechanism 32 electrically couples with the conductive surface 34. Finally, the user secures the replacement probing tip cartridge 26 in mating relationship with the main probing head body 24.

It should be noted that the present invention contemplates that the probing tip cartridge 26 may be disposable. Alternatively, the probing tip cartridge 26 may have a socket as a probing tip 30 so that broken tips could be replaced.

The terms and expressions that have been employed in the foregoing specification are used as terms of description and not of limitation, and are not intended to exclude equivalents of the features shown and described or portions of them. The scope of the invention is defined and limited only by the claims that follow.